HAZARDOUS SUBSTANCES EMERGENCY EVENTS SURVEILLANCE (HSEES)

Cumulative Report
2000-2001

New Jersey Department of Health and Senior Services
Trenton, New Jersey

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EXECUTIVE SUMMARY

Since 1990, the Agency for Toxic Substances and Disease Registry (ATSDR) has maintained an active, state-based Hazardous Substances Emergency Events Surveillance (HSEES) system to describe the public health consequences associated with the release of hazardous substances. Since 2000, the New Jersey Department of Health and Senior Services (NJDHSS) has participated in this surveillance system. This report summarizes the characteristics of events reported to the surveillance system by the NJDHSS during the years 2000 and 2001.

Information on acute hazardous substances emergency events was collected. The types of data collected include general information on the event, substance(s) released, number of victims, number and types of adverse health effects experienced by the victims, and the number of evacuations.

Several data sources were used to obtain the maximum amount of information about each event. The primary notification source was the New Jersey Department of Environmental Protection Communication Center. Data obtained were entered into an ATSDR web-based data entry system that allows for real-time data entry.

NJDHSS reported a total of 1,031 events for the years 2000-2001; 956 (93%) of the events occurred at fixed facilities, and 75 (7%) were transportation related. Equipment failure was the primary factor for the majority of the releases, causing 299 releases (29%). In 963 events (93%), only a single substance was released. The most commonly reported categories of substances were other organic substances and volatile organic compounds. During this reporting period, 73 events (7%) resulted in a total of 144 victims. The adverse health effects most frequently experienced by victims were respiratory problems, eye irritation, and dizziness/CNS. No one died as a result of any of these events, although 172 (17%) events required ordered evacuations.

The number of events, the number of evacuations, and the number of victims per event were consistent between the years 2000 and 2001. There was a lower proportion of transportation events in 2001 than 2000.

HAZARDOUS SUBSTANCES EMERGENCY EVENTS SURVEILLANCE (HSEES)

INTRODUCTION

The surveillance system has four goals:

- To describe the distribution and characteristics of hazardous substances emergencies,
- To describe the morbidity and mortality experienced by employees, responders, and the general public as a result of hazardous substances releases,
- To identify risk factors associated with the morbidity and mortality, and
- To identify strategies that might reduce future morbidity and mortality resulting from the release of hazardous substances.

This report summarizes the characteristics of hazardous substances releases and the associated public health consequences of events reported to the surveillance system during the years 2000 and 2001.

METHODS

Releases are eligible for inclusion if they are uncontrolled or illegal and require removal, cleanup, or neutralization according to federal, state, or local law. Threatened releases are also included in the system if 1) they involve actions such as evacuations which are taken to protect the public health and 2) they would have required removal, cleanup, or neutralization according to federal, state, or local law. A substance is considered hazardous if it can be reasonably expected to cause injury or death to an exposed person. Releases to air and water that could not be cleaned up are also included in the system if the amount released would have needed to be cleaned up if the spill had occurred on land. Events involving only petroleum products are excluded.

The primary notification source was the New Jersey Department of Environmental Protection Communication Center. For each event, information collected included: type of event (fixed facility or transportation related event); substance(s) released (identity, chemical form, type of release, and quantity released); victim(s) (population group, type of injury sustained, medical outcome, demographics, personnel protective equipment worn, and distance from the event); the type of area in which the event occurred; date and time of occurrence; numbers of persons potentially affected; use of environmental sampling; evacuations; response plans; and causal factors.

Emergency events captured by HSEES are classified according to whether they occur at fixed facilities or during transportation. A fixed facility event is an event that

occurs at a permanent facility such as an industrial site, school, or farm. A transportation event is an event that occurs while a hazardous substance is being shipped (via surface, water, air, or pipeline transportation). Victims are defined as individuals with symptoms (including psychological stress) or injuries that result from the event. Victims who receive more than one type of injury are counted once in each applicable injury category.

Substances are grouped into 11 categories: acids, ammonia, bases, chlorine, mixtures, paints and dyes, pesticides, polychlorinated biphenyls, volatile organic compounds (VOCs), other inorganic substances, and other substances. The mixtures category consists of chemicals from different categories that are mixed before release, and the other substances category consists of chemicals that cannot be classified into any one of the other 10 chemical categories. The category other inorganic substances comprises all inorganic substances except acids, bases, ammonia, and chlorine.

Data were entered into an ATSDR web-based data entry system. ATSDR provides NJDHSS with its own state-level data for analysis and report generation purposes. HSEES data are used for prevention activities by ATSDR and NJDHSS.

RESULTS

A total of 1,031 hazardous substances emergency events were reported by NJDHSS in the years 2000-2001 to the HSEES system; 30 (3%) of these events were threatened releases. Table 1 presents the number of events by event type. There were 956 (93%) events at fixed facilities, and 75 (7%) events were transportation related. Although the number of total events increased slightly in 2001 from 2000 (524 versus 507 respectively), there were half as many transportation events in 2001 than the previous year (25 versus 50, respectively).

Table 2 shows the number of events by county and type of event. The counties with the most fixed facility events were Gloucester (180 events) and Middlesex (144 events). The county with the most transportation related events was Middlesex (12 events).

The known areas that were involved in fixed facilities events (Figure 1) were process vessels (37%), piping (13%), ancillary process equipment (10%), above ground storage (6%), material handling areas (4%), transportation within the facility (3%), indoor living areas (2%), waste area (2%), heating/cooling (2%), and incinerator (1%). Other miscellaneous areas accounted for 16% of the events. In transportation related events where the mode of transportation was known, 84% occurred during ground transport (for example, truck, van, or tractor), and 9% involved transport by rail (Figure 2). The remaining transportation related events involved water (5%) and pipeline (2%) transport.

The primary factors contributing to events were also reported (Figure 3). Equipment failure was the primary factor in 299 events (29%), followed by human error in 192 events (19%), system/process upsets in 116 events (11%), and system start-up/shutdown in 79 events (8%). Two hundred and thirty events (22%) were caused by

other factors, and in 115 events (11%) the primary factor was unknown. Secondary factors contributing to events were reported for 103 events (10%). Secondary contributing factors included system/process upset (19 events), other factors (18 events), fire (14 events), equipment failure (11 events), improper packing (9 events), while performing maintenance (9 events), human error (7 events), and improper mixing (5 events).

Only one substance was involved in 93% of all the events. Two substances were involved in 5% of the events, and 1% of the events involved more than two substances (Table 3).

Of the chemicals that were either released or threatened to be released, 1,100 (97%) of the substances were actually released, 32 (3%) of the substances were threatened to be released, and two (0.2%) of the substances were partially released and partially threatened to be released. The number of substances released was greater than the number of events as more than one substance was released in some events. Most substances released were either air emissions (55%), spills (37%), or fires (6%). One percent were from other types of releases or combinations of types of releases, and six percent were unknown. Of the air emissions, 98% occurred in fixed facility events. Of the spills, 81% occurred in fixed facility events.

Of the events with known time of occurrence, 37% occurred from 6 AM to noon, and 33% from noon to 6 PM. Approximately 20% of events occurred on a Saturday or Sunday. Although events were spaced throughout the year, there were more events reported during each of the consecutive months of May, June, and July than any other individual month. For 2000 and 2001 combined, 340 (33% of all events) occurred in May, June, and July.

SUBSTANCES

Of the 11 categories into which HSEES substances were grouped, the categories of substances most commonly involved in fixed facility events were other inorganic substances (44%) and volatile organic compounds (23%) (Table 4). In transportation related events, volatile organic compounds (32%) and acids (24%) were most frequently involved. The ten substances most frequently involved in New Jersey for the years 2000-2001 are listed in Table 5. Carbon monoxide was the most frequently reported substance, occurring in 191 events (19%).

VICTIMS

A total of 144 victims were involved in 73 events (7% of all events) (Table 6). Of these events, 63% involved only one victim, 15% involved two victims, and 22% involved three or more victims. There were approximately an equal percentage of fixed facility and transportation events that resulted in injury (7% and 8%, respectively).

The type of substance most frequently involved was not the type of substance most likely to result in victims or injuries (Table 7). Although other inorganic substances were released during 469 events, only 16 (3%) of these events resulted in 25 victims (17% of all victims). Conversely, mixtures were involved in only 23 events, and nine of these events (39%) resulted in 27 victims (18% of all victims). Chlorine was involved in 22 events, and eight of these events (36%) resulted in 11 victims (8% of all victims). Mixtures and chlorine events posed a greater potential for immediate harm than any of the other categories.

Of the 144 victims, the population group most often adversely affected was employees (66%) (Figure 4). There were 24 first responders who were victims (17% of all victims): 22 first responder victims were in fixed facility events and 2 first responder victims were in transportation related events. The population group of one victim was unknown. Victims who were members of a company response team were categorized as responders, and not as employees.

There were no deaths that resulted from the hazardous substances releases. The types of adverse health effects sustained by victims are shown in Table 8 and Figure 5. The 144 victims sustained a total of 233 known adverse health effects. The most commonly reported adverse health effects in fixed facility events were respiratory system problems (26%), dizziness/CNS (14%), and eye irritation (13%). In transportation related events, trauma (27%), eye irritation (27%), respiratory system problems (20%), and shortness of breath (20%) were reported most frequently. Trauma was reported more frequently in transportation related events (27%) than in fixed facility events (5%). The trauma might have been caused by the sequence of events (for example, a motor vehicle accident) leading to the release of a hazardous substance, and not necessarily by exposure to the hazardous substance itself.

There was a different distribution of some types of injuries experienced by victims in 2001 than in 2000. For example, there were 23 victims who reported headaches in 2001 (during 6 events), while there were no headaches reported in 2000. There were 12 victims who reported skin irritation in 2001 (during 7 events), as compared to 1 victim in 2000.

The gender of 88% of the victims was known. Of these, 84% were male. Among the population categories, all of the emergency responders were male, while only half of the students were male. The age of 72% of the victims was known. Of these, the mean age was 35 years (range: 9-80 years of age). Of the 129 victims with known treatment, 105 victims (81%) were transported to the hospital. Of the victims transported to a hospital, 87 (83%) were treated and released, 15 (14%) were admitted, and 3 (3%) were observed without treatment (Figure 6).

The percent of victims by population category who wore personal protective equipment (PPE) was 16% of employees, 47% of first responders, and 56% of students. Of employee victims reported as wearing PPE, 52% wore gloves. Of student victims reported as wearing PPE, 80% wore eye protection. Of the first responder victims

reported as wearing PPE, 63% wore Level C PPE. Level C protection is worn when skin exposure is not a concern, the air contaminants have been identified, the chemicals are not at a concentration of immediate concern, and the atmosphere contains at least 19.5% oxygen. Level C equipment includes a full-face air-purifying respirator, chemical-resistant clothing and safety boots, a hardhat, and two-way communication.

EVACUATION

Evacuations were ordered in 172 (17%) events, with the evacuation status of 29 events (3%) being unknown. Of the 172 ordered evacuations, 120 (70%) were of a building or the affected part of a building, 16 (9%) were of a circle around the event and/or areas downwind of the event, and eight (5%) had no defined criteria. The evacuation criteria of 28 ordered evacuations (16%) was unknown. The median number of persons evacuated was 18 (range: 1-2400), and the median length of evacuation was 10 hours (range: less than 1 hour-1800 hours). In six events, in-place sheltering was ordered by an official, and instructions regarding precautions to take during in-place sheltering were provided by an official in two of these events.

CONTINGENCY PLANS

The types of contingency or preparedness plans used during an event varied. Of the 927 events where a contingency plan was reported to be used, company operating procedures were used in 650 events (70%), HAZMAT/response team operating procedures were used in 238 events (26%), site specific ad hoc procedures were used in 19 events (2%), and a RCRA contingency plans was used in nine events (1%).

CHLORINE AND CHLORINE-BASED CHEMICALS

Chlorine and chlorine products are commonly used in industry (including water treatment plants) and in household products. The general public can be exposed to chlorine and chlorine based products from both household cleaning products, swimming pool disinfection products, and industrial releases. Children can be exposed to chlorine and chlorine-based products while at home or at day care or school. Because of both the widespread use of chlorine and chlorine-based chemicals and the high morbidity rate from HSEES-reported chlorine releases, additional analyses of events that involve chlorine and chlorine-based chemicals were conducted to determine if these chemicals were responsible for a greater proportion of injury and evacuations.

As a category, chlorine was involved in 22 events. However, other categories of substances also included chlorine-based substances. Hydrochloric acid (classified as an acid) was involved in 34 events, sodium hypochlorite (classified as other inorganic substance) was involved in 25 events, bleach (classified as a volatile organic compound) was released in three events, and liquid plumber (classified as an other inorganic substance) was involved in one event. In total, 81 events involved one or more chlorine or a chlorine-based chemical.

Seven of these events were transportation events and 74 occurred at a fixed facility. Human error was the primary factor in 30% of these events and equipment failure was the primary factor in 28% of these events. The age of the victims ranged from ten to 58 years old. Locations of the events included industrial sites, private residences, adult care facilities, and trash collection.

Events that involved chlorine or chlorine-based chemicals caused a higher rate of injury than to all other events (26% versus 5%). Of the 81 events (8% of all events) that involved one or more chlorine or a chlorine-based chemical, 21 events resulted in 30 victims (21% of all victims). Also, a greater percentage of evacuations were ordered due to these events than to all other events (41% versus 14%).

Six events where bleach was used or mixed with other household products injured eight victims (6% of all victims). Because chlorine and chlorine-based chemicals were responsible for a relatively high percent of victims, NJDHSS is developing a prevention outreach program to educate higher risk populations and to prevent events and injuries from mixing bleach or other chlorine containing products with ammonia or other household products.

SUMMARY OF RESULTS, 2000–2001

The number of events meeting surveillance definitions, substances involved, and events with victims for the years 2000 and 2001 are shown in Table 9 and Figure 7. The distribution of the total number of victims by population group and year is shown in Figure 8. Other results and findings of this report include:

- the number of events, the number of evacuations, and the number of victims per event were consistent between the year 2000 and the year 2001;
- there was a lower percent of transportation events in 2001 than 2000;
- most events involved a single substance at a fixed facility;
- equipment failure was the primary cause of most of the events;
- other inorganic substances was the most commonly reported category of substance involved;
- employees were the most commonly reported victims of emergency events;
- respiratory system problems were the most often reported symptoms of victims;
- most victims were transported and treated at a hospital and then released (not admitted); and
- chlorine and chlorine-based chemicals accounted for a relatively high proportion of victims (as compared to all events).

The findings of this report provide NJDHSS with important and useful information regarding risk factors of and morbidity from hazardous substances emergency events. This information will be used to develop educational materials and programs focused on the most appropriate segment of the manufacturing, transportation, emergency response, and/or general population. In the future, HSEES may also be useful

for training hospital emergency room personnel who may treat victims of emergency events resulting from accidental spills or acts of terrorism.

Table 1 - Number of events meeting the surveillance definition by year and type of event, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Year	Type of event				Total Number of events
	Fixed facility		Transportation		
	Number of events	Percent	Number of events	Percent	
2000	457	90.1	50	9.9	507
2001	499	95.2	25	4.8	524
Total	956	92.7	75	7.3	1,031

Table 2 - Number of events meeting the surveillance definition by county and type of event, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

County	Type of event				Total number of events
	Fixed facility		Transportation		
	Number of events	Percent	Number of events	Percent	
Atlantic	8	72.7	3	27.3	11
Bergen	36	83.7	7	16.3	43
Burlington	37	100	0	0	37
Camden	47	95.9	2	4.1	49
Cape May	17	89.5	2	10.5	19
Cumberland	72	97.3	2	2.7	74
Essex	40	97.6	1	2.4	41
Gloucester	180	98.9	2	1.1	182
Hudson	23	76.7	7	23.3	30
Hunterdon	1	50.0	1	50.0	2
Mercer	44	88.0	6	12.0	50
Middlesex	144	92.3	12	7.7	156
Monmouth	23	88.5	3	11.5	26
Morris	26	81.2	6	18.8	32
Ocean	14	87.5	2	12.5	16
Passaic	30	88.2	4	11.8	34
Salem	57	100	0	0	57
Somerset	14	70.0	6	30.0	20
Sussex	1	33.3	2	66.7	3
Union	47	88.7	6	11.3	53
Warren	94	98.9	1	1.1	95
Unknown	1	100	0	0	1
Total	956	92.7	75	7.3	1,031

Table 3 - Distribution of the number of substances involved by type of event, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Number of substances involved	Type of event				All events	
	Fixed facility		Transportation			
	Number	Percent	Number	Percent	Number	Percent
1	899	94.0	64	85.3	963	93.4
2	45	4.7	9	12.0	54	5.2
3	4	0.4	2	2.7	6	0.6
4	4	0.4	0	0	4	0.4
5	4	0.4	0	0	4	0.4
Total	956	100	75	100	1,031	100

Table 4 - Distribution of the number of substances involved by substance category and type of event, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Substance category	Type of event				All events	
	Fixed facility		Transportation			
	Number substances	Percent	Number of substances	Perccnt	Number of substances	Percent
Acids	101	9.7	21	23.9	122	10.8
Ammonia	35	3.3	0	0	35	3.1
Bases	20	1.9	3	3.4	23	2.0
Chlorine	22	2.1	0	0	22	1.9
Mixtures*	20	1.9	3	3.4	23	2.0
Other inorganic substances	461	44.1	8	9.1	469	41.4
Other substances	102	9.8	11	12.5	113	10.0
Paints and dyes	24	2.3	6	6.8	30	2.6
Pesticides	24	2.3	7	8.0	31	2.7
Polychlorinated biphenyls	0	0.0	1	1.1	1	0.1
Volatile organic compounds	237	22.7	28	31.8	265	23.4
Total	1,046	100	88	100	1,134	100

* Mixtures of substances from different categories.

Table 5 - The ten most frequently reported substances, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Number	Standardized Substance Name	Frequency
1.	Carbon Monoxide	191
2.	Sulfur Dioxide	95
3.	Nitrogen Oxides	57
4.	Sulfuric Acid	39
5.	Chloroform	37
6.	Hydrochloric Acid	34
7.	Ammonia	33
8.	Hydrogen Sulfide	31
9.	Mercury	27
10.	Sodium Hypochlorite	25

Table 6 - Distribution of the number of victims by type of event, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Number of victims	Type of event				All events	
	Fixed facility		Transportation			
	Number of events	Percent	Number of events	Percent	Number of events	Percent
1	41	61.2	5	83.3	46	63.0
2	11	16.4	0	0	11	15.1
3	7	10.4	1	16.7	8	11.0
4	2	3.0	0	0	2	2.7
5	3	4.5	0	0	3	4.1
6	3	4.5	0	0	3	4.1
Total	67	100.0	6	100.0	73	100.0

Table 7 - Number of substances involved in all events and events with victims by substance category, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Substance category	Substances involved in events		Substances involved with events that caused injury		Percent of substance events resulting in victims
	Number	Percent	Number	Percent	
Acids	122	10.8	16	18.0	13.1
Ammonia	35	3.1	4	4.5	11.4
Bases	23	2.0	3	3.4	13.0
Chlorine	22	1.9	8	9.0	36.4
Mixtures	23	2.0	9	10.1	39.1
Other inorganic substances	469	41.4	16	16.9	3.4
Other, not otherwise specified	113	10.0	8	9.0	7.1
Paints and dyes	30	2.6	1	1.1	3.3
Pesticides	31	2.7	3	3.4	9.7
Polychlorinated biphenyls	1	0.1	0	0	0
Volatile organic compounds	265	23.4	22	24.7	8.3
Total*	1,134	100	89	100	7.9

*Total exceeds total number of events because events at which more than one substance was released were counted more than once.

Table 8 - Distribution of type of adverse health effect by type of event,* Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Type of adverse health effect	Type of events				All events	
	Fixed facility		Transportation			
	Number	Percent	Number	Percent	Number	Percent
Thermal Burns	18	8.3	0	0	18	7.7
Chemical Burns	4	1.8	0	0	4	1.7
Heart problems	1	0.5	0	0	1	0.4
Dizziness/CNS†	30	13.8	0	0	30	12.9
Eye irritation	29	13.3	4	26.7	33	14.2
Headache	23	10.6	0	0	23	9.9
Heat stress	0	0	0	0	0	0
Gastrointestinal problems	23	10.6	0	0	23	9.9
Respiratory problems	56	25.7	3	20.0	59	25.3
Shortness of breath	1	0.5	3	20.0	4	1.7
Skin irritation	13	6.0	0	0	13	5.6
Trauma	10	4.6	4	26.7	14	6.0
Other	10	4.6	1	6.7	11	4.7
Total	218	100	15	100	233	100

* The number of injuries is greater than the number of victims because a victim could have had more than one injury.

† Central nervous system symptoms.

Table 9 – Total number of events, substances, and victims, Hazardous Substances Emergency Events Surveillance, New Jersey, 2000-2001.

Year	Type of event			Number of substances involved	Number of deaths	Number of victims	Events with victims	
	Fixed facility	Transport	Total				Number	Percent
2000	457	50	507	538	0	69	38	7.5
2001	499	25	524	596	0	75	35	6.7
Total	956	75	1,031	1,134	0	144	73	7.1

Figure 1 - Known areas of fixed facilities involved in events

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

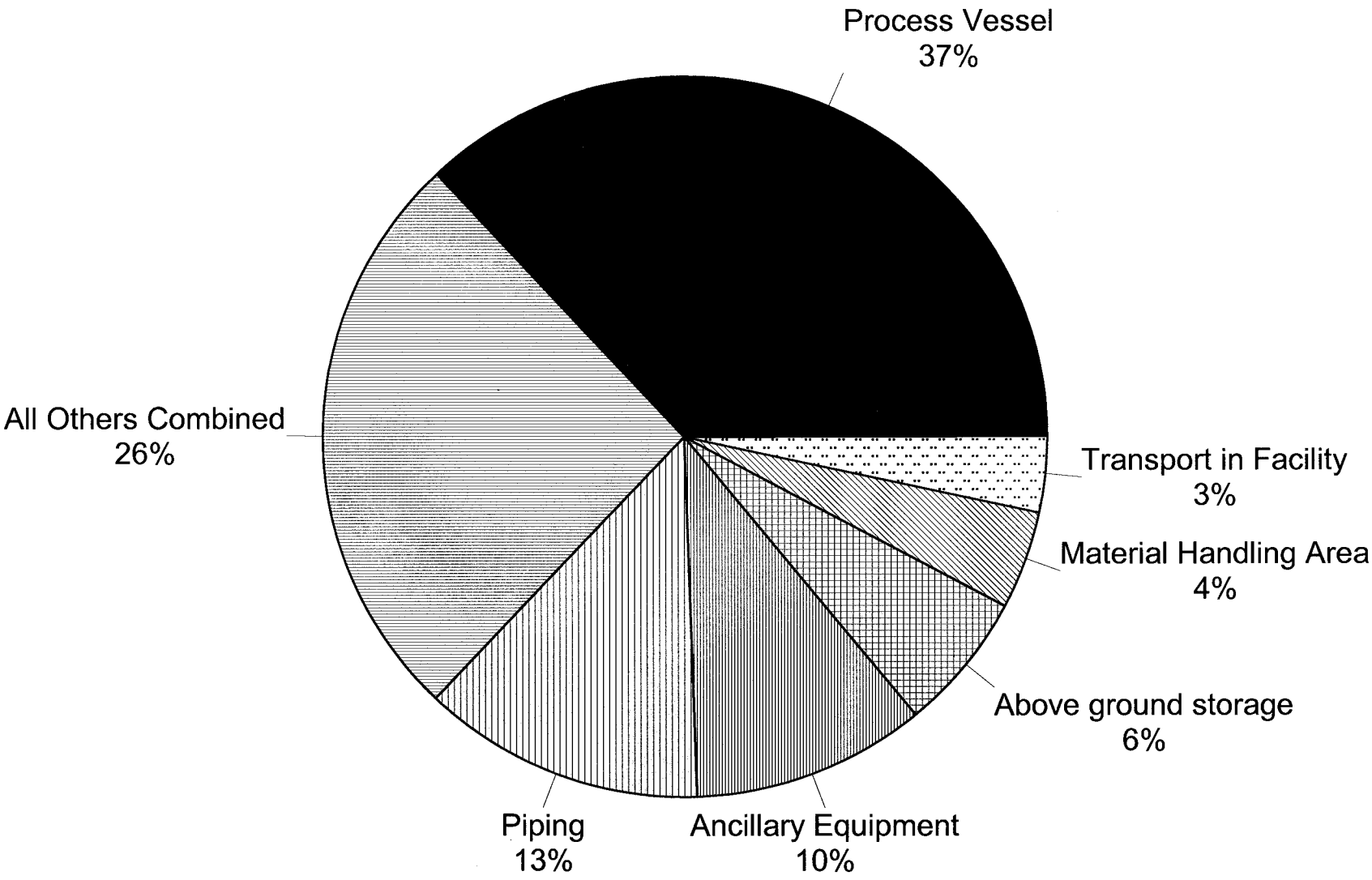

Figure 2 - Distribution of transportation-related events by known type of transport

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

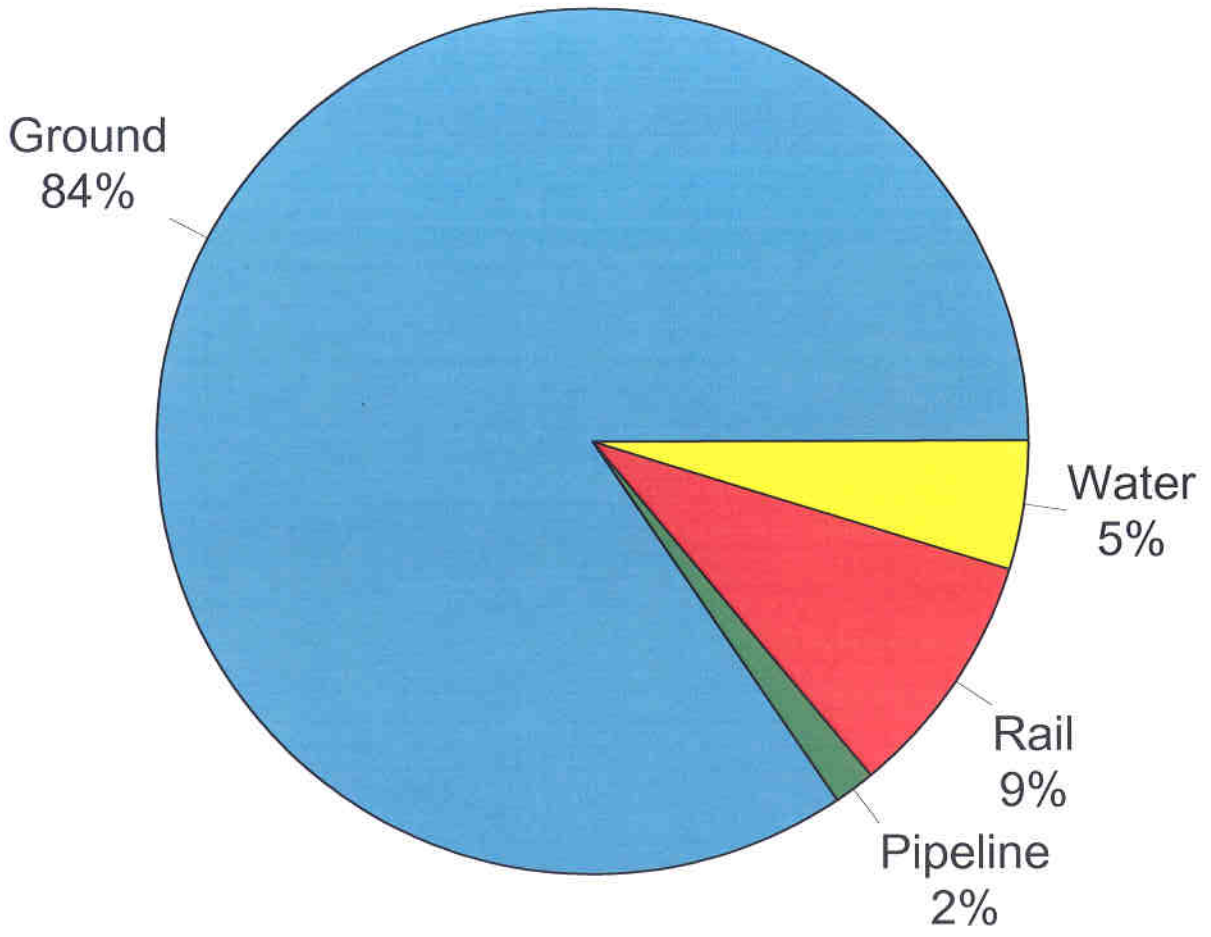

Figure 3 - Primary factors contributing to the occurrence of fixed-facility events

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

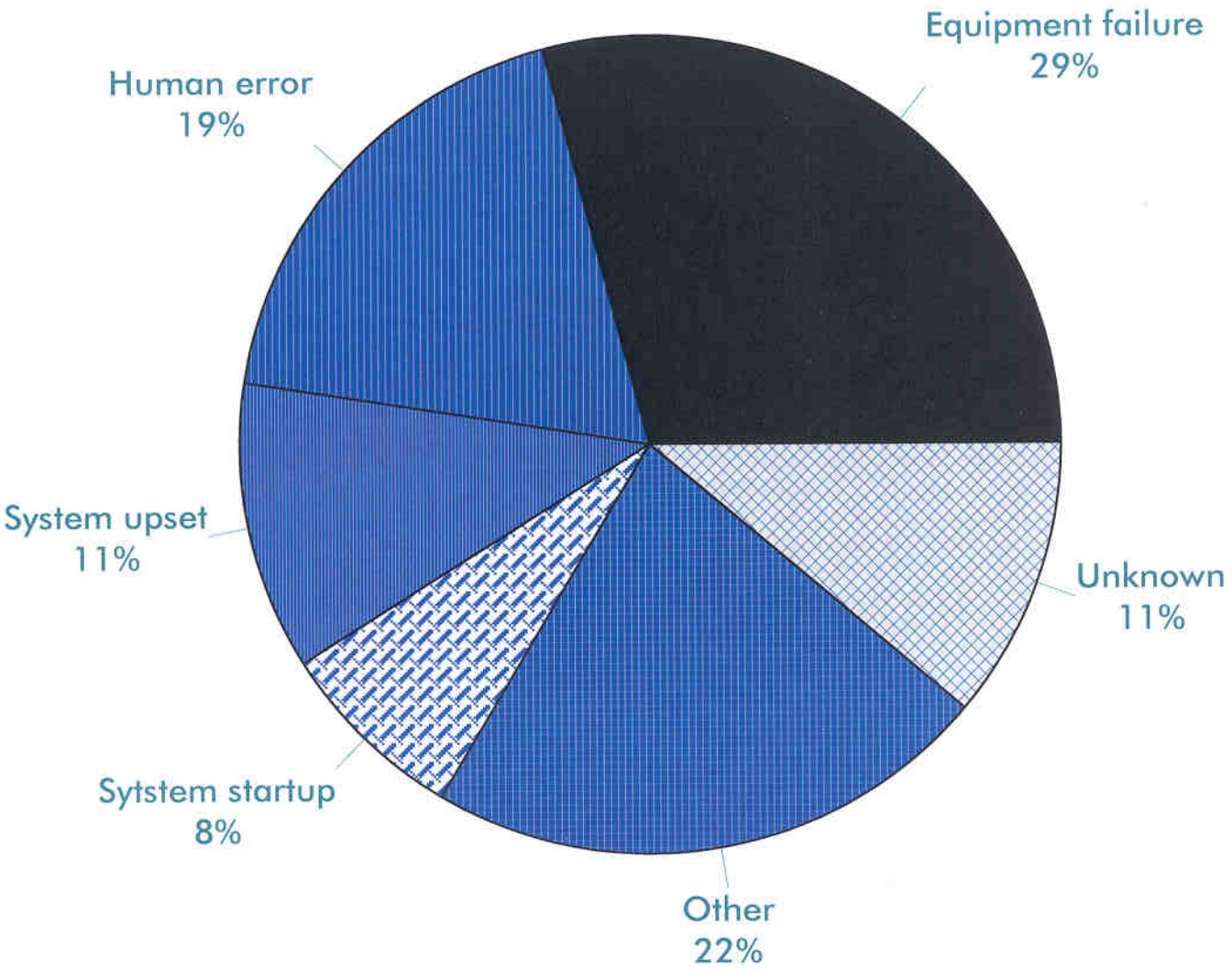

Figure 4 - Distribution of victims by population group and type of event

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

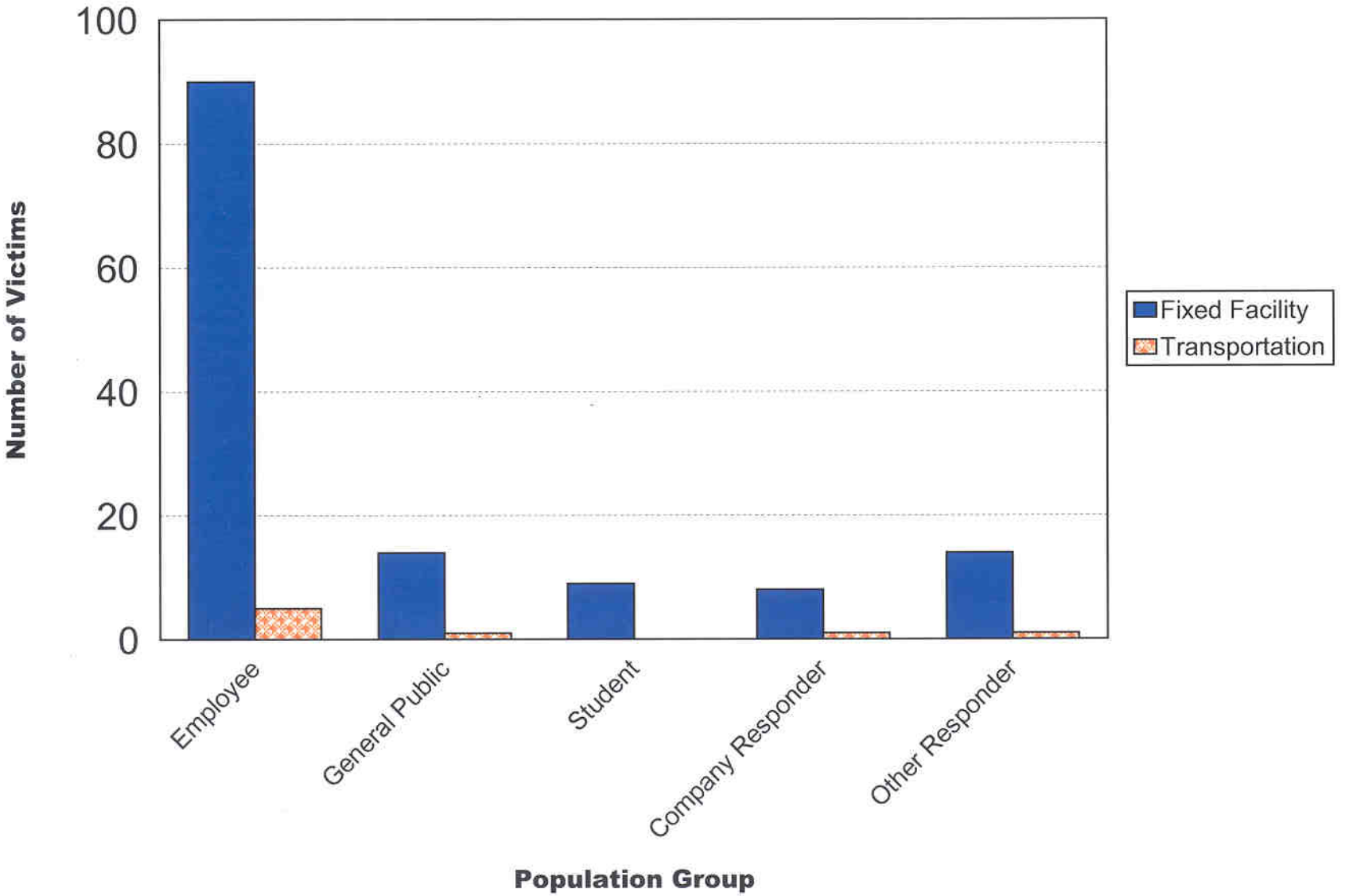

Figure 5 - Distribution of type of injury for all events

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

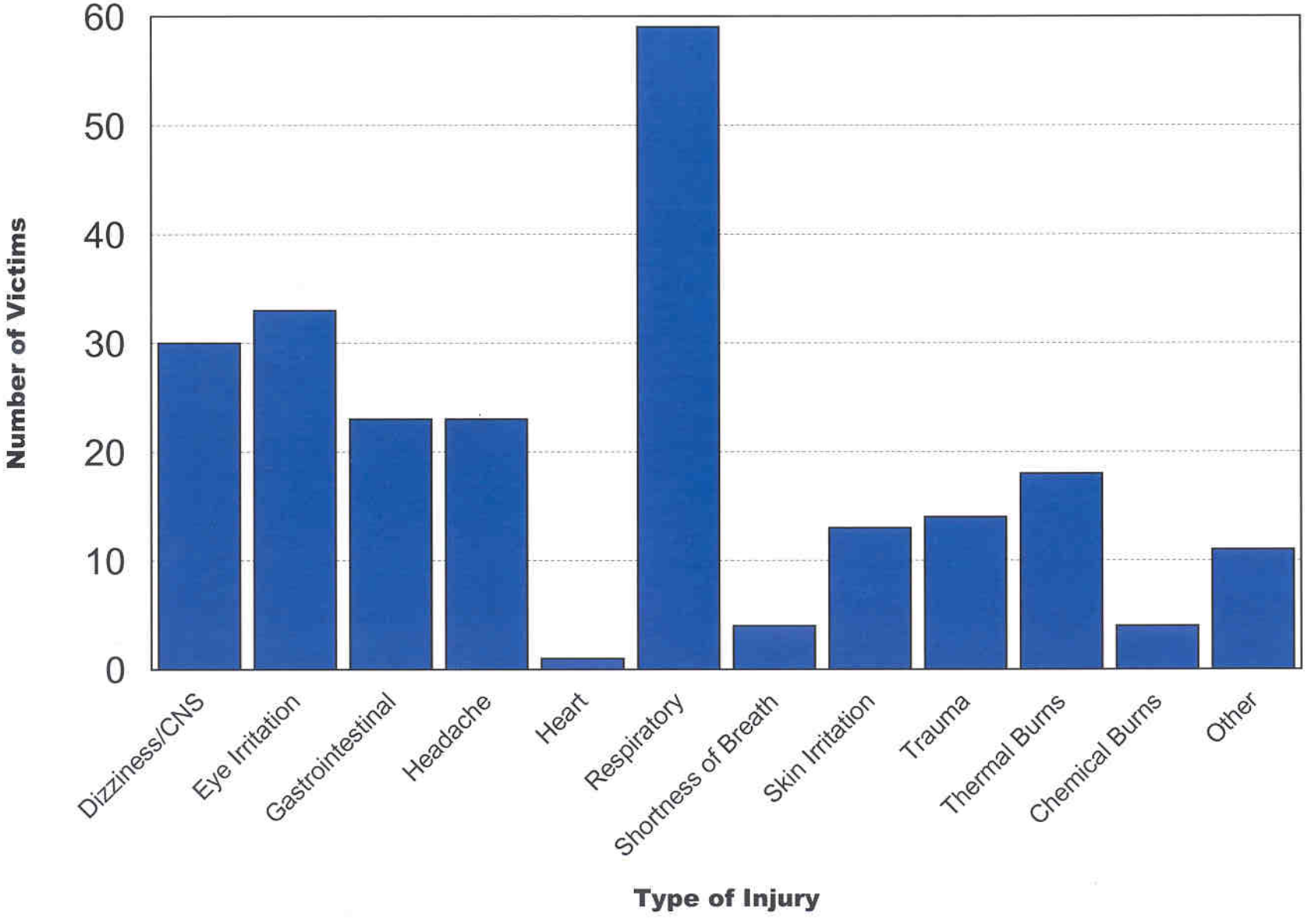

Figure 6 - Severity of known victim injuries and ouctomes

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

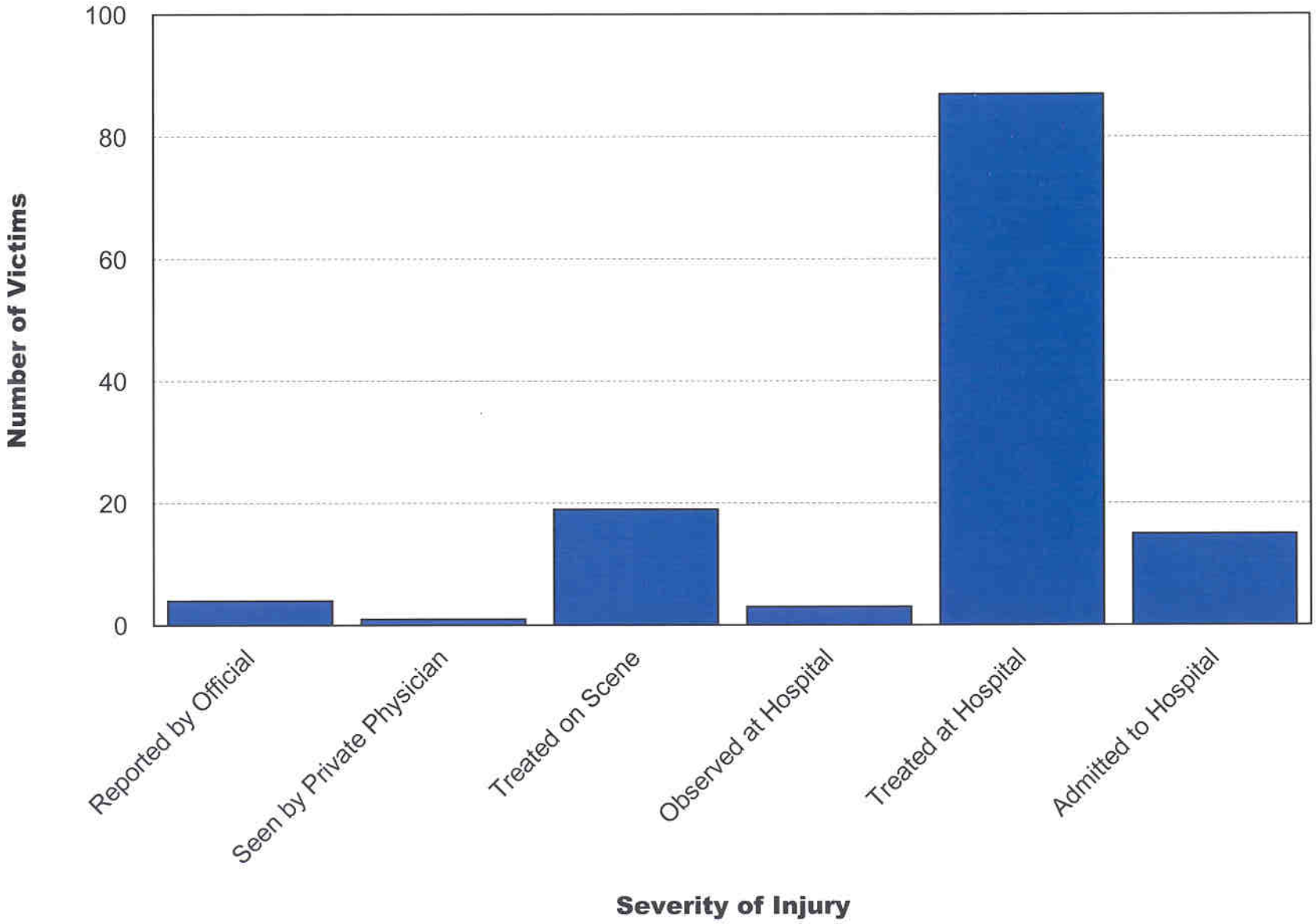

Figure 7 - Total events, substances, and victims

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001

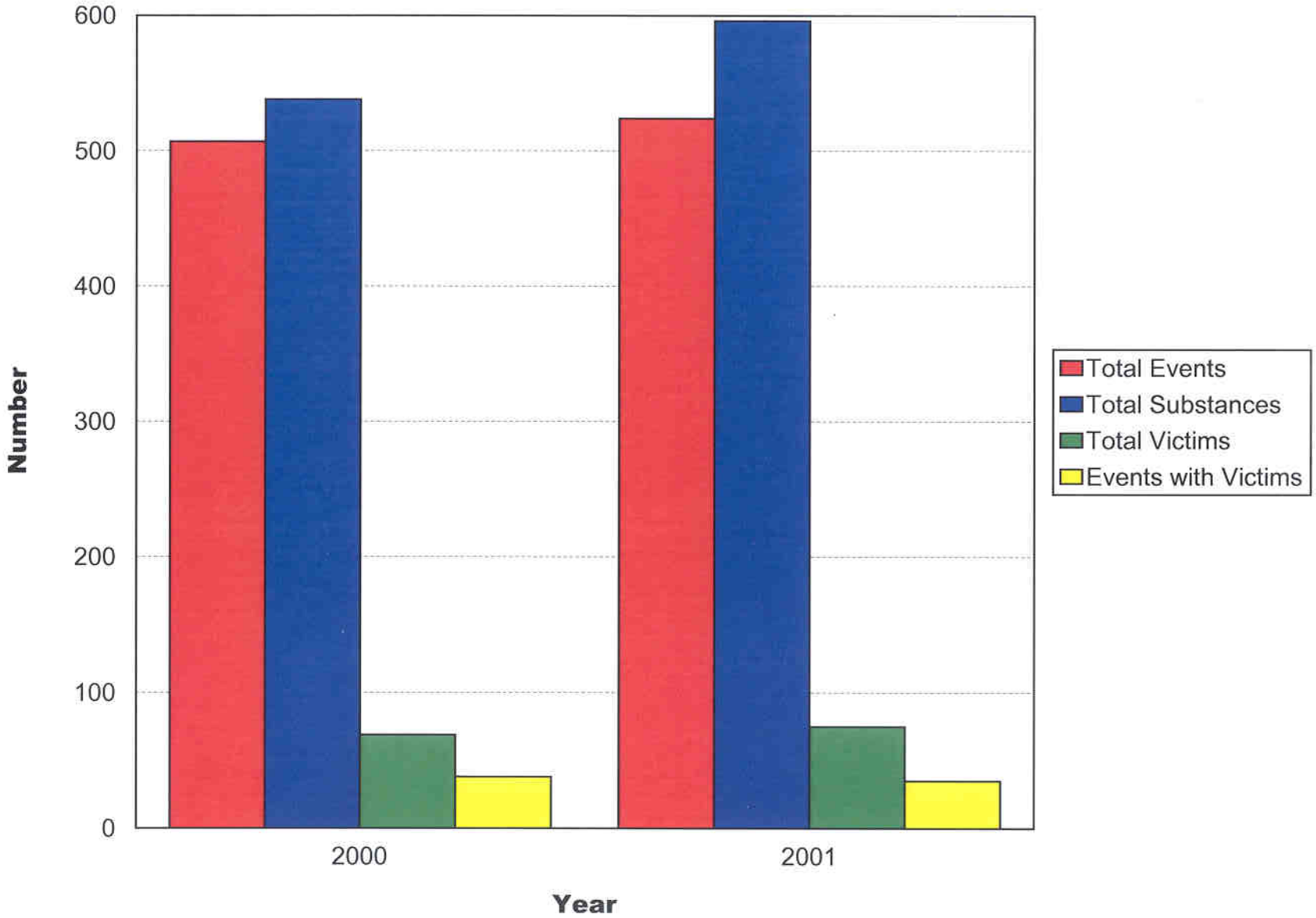

Figure 8 - Distribution of victims by population group and year

Hazardous Substances Emergency Events Surveillance
New Jersey, 2000-2001